International Journal of Surgery 12 (2014) 936–939

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Original research

Paravertebral block for video-assisted thoracoscopic surgery: Analgesic effectiveness and role in fast-track surgery

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ARTICLE INFO

Article history:
Received 14 December 2013
Accepted 29 July 2014
Available online 1 August 2014

Keywords:
Paravertebral block
Video-assisted thoracic surgery (VATS)
Fast-track surgery
Enhanced recovery after surgery (ERAS)

ABSTRACT

Background: Appropriate postoperative analgesia is crucial in fast-track surgery, which is a multimodal therapeutic strategy that aims toward enhanced postoperative recovery and shortened hospital stay. Paravertebral block (PVB) has been reported to be as effective as thoracic epidural blockade (TEB), but PVB is not often employed for video-assisted thoracoscopic surgery (VATS) for 2 reasons. First, TEB is still the gold standard for thoracic surgery, and second, thoracoscopic insertion of a PVB catheter is challenging. **Methods**: In this retrospective observational study, 185 patients who underwent VATS and thoracoscopic paravertebral catheterization were analyzed. Postoperatively, the patients were continuously administered a local anesthetic (0.5% bupivacaine hydrochloride or 0.2% ropivacaine hydrochloride). Additionally, they were given an oral non-steroidal anti-inflammatory drug (NSAID) as needed. Intramuscular/intravenous pentazocine was administered as a rescue medication. The effect of pain control was measured in terms of the frequency of NSAID taken orally and the necessity for a rescue drug on postoperative days (POD) 0, 1, 2, and 3. **Results**: The mean age of the 185 patients included in the study was 67 years (Confidence Interval: 66–69). The mean frequency of NSAID use was 0.67 (0–3), 1.59 (0–4), 1.43 (0–4), and 1.33 (0–4) on POD 0, 1, 2, and 3, respectively. 32 (17.3%) and 3 patients (1.6%) were administered a rescue medication on POD 0 and 1, respectively. The most common postoperative complication was nausea/vomiting, which occurred in 17 patients (9.1%). **Conclusions**: PVB may greatly contribute to enhanced recovery after thoracic surgery owing to effective analgesia and fewer side effects.

1. Introduction

Fast-track surgery and enhanced recovery after surgery (ERAS) are concepts related to perioperative care that were first introduced by Kehlet and colleagues in the 1990s, mainly in the field of elective abdominal surgery [1]. This approach mainly aims at a shortened hospital stay with accelerated postoperative recovery by attenuating the stress response to surgery [2,3]. Fast-track gastrointestinal surgery has been well discussed [3–5], but there have been few reports regarding fast-track programs for lung surgery [6,7].

In addition, consideration of analgesia is one component of fast-track surgery that should never be ignored [2]. Thoracic epidural blockade (TEB) has long been considered the gold standard for thoracotomy pain. However, several studies of thoracic analgesia have suggested that paravertebral blockade (PVB) is as effective as TEB with a favorable side effect profile. [8–10] Although video-assisted thoracoscopic surgery (VATS) has recently been increasing in popularity, some authors have pointed out that optimal postoperative analgesia following VATS remains to be elucidated [11].

This study was designed to analyze the analgesic effectiveness of PVB for patients undergoing VATS and the potential for PVB as an alternative to TEB for fast-track surgery.

2. Materials and methods

2.1. Study design

This was a retrospective, non-randomized, uncontrolled study of a cohort of patients undergoing VATS.

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http://dx.doi.org/10.1016/j.ijsu.2014.07.272
1743-9191/

2.2. Data collection

All relevant data were collected by reviewing the medical charts of patients undergoing VATS and PVB catheterization during the designated period.

2.3. Techniques used for VATS and subsequent PVB catheter insertion

Our VATS approach consisted of 3 incisions. The largest of these is a utility incision of about 5 cm located over the 4th or 5th interspace without a rib spreader being applied. The other 2 incisions measure approximately 10 mm and are made for inserting the thoracoscopic video-probe and surgical instruments.

2.4. PVB catheterization

As is the case in a standard thoracotomy, an indwelling extrapleural catheter (typically used for epidural block: Epidural Catheterization Set, Allow International Inc., Pennsylvania, USA) is put in place just before the closure of each incision. At the posterior end of the small thoracotomy incision (the utility incision), the parietal pleura is incised vertically with electrocautery for 2 to 3 interspaces above and below the level of the thoracotomy. We usually incise the parietal pleura down to the 7th or 8th intercostal space, which is the same interspace as that of the lowest thoracoscopic port. By gently grasping the edge of the parietal pleura and applying traction downward, the parietal pleura is bluntly dissected and lifted away from the inner chest wall to form an extrapleural pocket. An 18-gauge catheter is then placed percutaneously into this extrapleural space under thoracoscopic visualization. In its final position, the lower portion of the catheter is within the inferior part of the pocket and the tip is in the superior portion of the pocket. It is very important that the lifted parietal pleura is intact in the area of the extrapleural pocket so that the infused local anesthetic (LA) can easily spread throughout the extrapleural space without leaking through a torn area. Once the extrapleural pocket is filled, the LA induces an intercostal nerve blockade [12]. Following lung re-inflation, we administered the LA intermittently through the PVB catheter to reach a final dosage of 15 mL at the completion of chest closure. After the patient has been transferred back to the recovery room, a continuous infusion of 0.5% bupivacaine hydrochloride (Marcaine Plain; Astra, Osaka, Japan) or 0.2% ropivacaine hydrochloride (Anapeine; Astra, Osaka, Japan) is started through an infusion pump.

Postoperatively, patients were strongly encouraged to take a painkiller, if needed, to ensure a good cough effort and rigorous physiotherapy. An oral non-steroidal anti-inflammatory drug (NSAID, loxoprofen sodium hydrate, Loxonin; Daiichi-Sankyo, Tokyo, Japan) was used for this purpose. In case of an analgesic failure with the NSAID, intramuscular/intravenous pentazocine hydrochloride (Pentagin; Daiichi-Sankyo, Tokyo, Japan) was used as a rescue medication. The effect of pain control on postoperative days (PODs) 0, 1, 2, and 3 was measured by determining whether (1) patients were able to achieve a cough sufficient to clear the airway, (2) how often they took the NSAID, and (3) whether they were given a rescue drug to supplement the efficacy of the NSAID. Postoperative complications were also recorded.

2.5. Statistical analysis

Parametric data are presented as the mean with 95% confidence intervals, and non-parametric data as the median and interquartile range (IQR). Electronic software (Excel, Microsoft Corporation, Seattle, WA) was used for statistical analyses.

3. Results

Between May 2010 and December 2012, 185 patients underwent thoracoscopic PVB catheterization for pain management after VATS. Patient demographics, including surgical details and diagnosis, are shown in Table 1.

0.5% bupivacaine hydrochloride was administered to 115 patients and 0.2% ropivacaine hydrochloride to 70 patients. The mean frequency of oral NSAID use and the number of patients who received a rescue medication for 3 days following surgery are shown in Table 2. Five patients (2.7%) did not require any pain medication, and 175 patients (94.6%) were capable of a good cough in the recovery room or intensive care unit. Postoperatively, all of the patients could participate in a rigorous physiotherapy program. There were 2 cases of postoperative pneumonia and the patients were administered intravenous antibiotics (Table 3).

4. Discussion

Minimally invasive surgery, which is a laparoscopic technique used in abdominal surgery, is one of the most important modalities for performing fast-track surgery [2]. In the field of thoracic surgery, VATS is considered to be minimally invasive. According to the studies comparing VATS and open thoracotomy, VATS is associated with fewer in-hospital postoperative complications and a shorter hospital stay [13–15]. Therefore, VATS should play an important role in fast-track surgery. Another important consideration for fast-track surgery is optimal pain management, especially in the first 3 PODs [16,17], during which an epidural blockade is usually performed, as it is in colorectal surgery [2]. However, recent studies

Table 1
Patient demographics and perioperative data.

Age (years)[a]	67 (66–69)
BMI[a]	22.1 (21.7–22.5)
ASA score 2/3 (*n*)	152/33
Sex (male/female)	99/86
Type of surgical procedure	
Lobectomy	123
Bilobectomy	2
Lobectomy and wedge resection	2
Lobectomy and segmentectomy	1
Lobectomy and mediastinoscopy	1
Segmentectomy	27
Wedge resection	24
Decortication	1
Repair of pneumothorax	1
Ligation of the anomalous vessel	1
Exploration	2
Duration of surgery (min.)[a]	168 (159–178)
Intraoperative bleeding (ml)[b]	82.2 (68.8–95.6)
Diagnosis	
Non-small cell lung cancer	146
Small cell lung cancer	1
Carcinoid	2
Metastatic lesion	4
Mycobacterium avium complex infection	11
Pneumothorax	2
Giant bulla	2
Organizing pneumonia	4
Empyema	1
Abscess	1
Interstitial pneumonia	1
Hamartoma	1
Others	9
Duration of PVB catheter (Median)[a]	2 (1–2)
Day of discharge (POD) (Median)[b]	7 (5–9)

BMI: body mass index; ASA score: American Society of Anesthesiologists score.
[a] Mean (95% confidence interval).
[b] Median (interquartile range).

Table 2
The mean frequency of non-steroidal anti-inflammatory drug (NSAID) use for 3 days following surgery.

	POD 0	POD 1	POD 2	POD 3
Rescue medication given (*n* [%])	32 (17.3%)	3 (1.6%)	0	0
Frequency of NSAID use	0.67 (0–3)	1.59 (0–4)	1.43 (0–4)	1.33 (0–4)

have shown that thoracic PVB is as effective as TEB [8–10]. Elsayed and a colleague advocate the usefulness of PVB in a thoracic fast-track program [18,19], but currently, PVB is not widely practiced for post-thoracotomy analgesia, especially for VATS. At present, there is no consensus for the optimal postoperative pain management approach adopted following VATS [20–22]. Therefore, we focused our analysis on the assessment of pain management by PVB for the first 3 PODs among patients undergoing VATS and on the potential role of PVB in thoracic fast-track surgery.

Although this was not a controlled study, we found that PVB could offer acceptable analgesia for patients undergoing VATS for 3 reasons. First, 82.7% of patients could tolerate postoperative pain with an oral NSAID alone. Second, there were almost no pain-related postoperative pulmonary complications, whereas in the report by Agostini and colleagues the incidence of postoperative pulmonary complications was 14.5% [23]. Finally, all of the patients were able to participate in an aggressive physiotherapy program.

As mentioned above, TEB plays an important role in fast-track surgery, but it is also known to cause adverse effects such as urinary retention (42%), nausea (22%), itching (22%), a prolonged operative time and technical failure (8%), hypotension (3%), and respiratory depression (0.07%) [12]. The epidural technique is also contraindicated in septic conditions, coagulation ailments, pre-existing neurological disorders, and cases of difficult vertebral anatomy [24]. The implementation of fast-track recovery requires appropriate analgesia with fewer side effects. In the present study, 17 patients (9.1%) experienced postoperative nausea/vomiting. We are not sure whether this complaint was PVB-related; however, considering the reported incidence of nausea even with TEB, our result is quite favorable. No other adverse effects similar to those of TEB were noted. PVB should thus also be considered because of its low side-effect profile. In cases of technical failure of TEB, difficult vertebral anatomy, and for the above-mentioned conditions for which TEB is contraindicated, PVB may be a good alternative. [25] For patients who have difficulty in cooperating with TEB catheterization under consciousness, for instance, patients who are extremely anxious or schizophrenic, PVB should also be appreciated.

4.1. Limitations

This was not a controlled study, and so we cannot conclude that PVB offers better analgesia for patients undergoing VATS than TEB.

Table 3
Postoperative complications after VATS.

Postoperative complications	(*n*)	(%)
Nausea/vomiting	17	9.10%
Atrial fibrillation	5	2.70%
Hypertension	2	1.00%
Prolonged air leakage	1	0.50%
Chylothorax	2	1.00%
Acute respiratory distress syndrome	1	0.50%
Bronchopleural fistula	1	0.50%
Pneumonia	2	1.00%
Hyperglycemia	1	0.50%
	32/185	17.30%

5. Conclusions

PVB for patients undergoing VATS offers good pain relief. Considering the ease of thoracoscopic placement of an extrapleural catheter and the low incidence of PVB-related side effects, this analgesic modality should be employed more frequently. PVB might take center stage in more sophisticated thoracic fast-track programs.

Ethical approval

Our study is a retrospective study in which patients' medical records were retrieved by us. Therefore, we did not put this study onto the Ethical Committee of Nagara Medical Center where this study was held.

Funding

None.

Author contribution

Please specify the contribution of each author to the paper, e.g. study design, data collections, data analysis, writing. Others, who have contributed in other ways should be listed as contributors.

Teruya Komatsu, M.D.; Corresponding author, in charge of study design, data collection, data analysis, and writing.

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Mari Inoue, R.N; Co-author, involved in data collections and data analysis from the ERAS perspective.

Conflicts of interest

None declared.

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